

Internal Business Process

Objective: Minimize Impact of the Aging Plant

Initiative: Inspect and Clean FW heater– Evaluate and Repair if Justified

Background: The boiler feedwater heaters are important pieces of equipment in the efficiency of the steam generation cycle. Every two years, the high pressure heater tubes are inspected with eddy current testing techniques. During the inspections over the past four years, the contractor has complained that the tubes are fouled with deposits that hinder the testing. Engineering Services formulated a test to determine if the fouling was also hurting heat rate and whether it was worth cleaning all the tubes rather than just those being tested.

Status: During the Spring 2007 Unit 1 Outage CEDA used high pressure water (~10,000 psi) to clean tubes in the high pressure heaters. A very small rotating nozzle was inserted into the tube and a flexible high pressure probe was run up and down the length of the heater tube. We only cleaned the horizontal surfaces, and did not attempt to clean the U section.

In heaters 6A, 7A, 7B, and 8A only 20% of the tubes were cleaned. Those were the tubes that were to be tested by eddy current. As a test, all of the tubes in Heater 8B tubes were cleaned. It was decided that one heater would have all the tubes cleaned and careful measurements of heater performance would be taken before and after the cleaning.

Results: The heater and cycle performance effects of this cleaning are summarized below:

Operational Heater Performance Improvement

	Pre-outage	Post-outage
TTD (Terminal Temperature Difference)	1.45°	-0.84°

These values are based on daily averages for 60 days prior to and following the outage with outliers for abnormal heater and cycle operation removed.

Reducing the TTD on this heater 2.3° improved cycle heat rate 0.05%, which equates to \$25,200 annual fuel savings provided the tubes remain clean. Since the cleaning cost was \$13,500, payback for the cost of the cleaning will be realized in approximately six months. We recommend that all HP heaters be cleaned at the next available outage.

Internal Business Process

Objective: Minimize Impact of the Aging Plant

Initiative: Complete Unit 1 Circ Water Line Repairs

During the 2007 outage, the following was accomplished to reinforce and protect the Prestressed Concrete Circulating Water Lines:

- 32 additional sections of pipe were reinforced with carbon fiber
- Coating was repaired on the original 38 sections that received carbon fiber in 2005
- Shorting straps were installed at the pipe joints so that the pipeline is now electrically continuous. A necessary first step for the installation of a cathodic protection system.
- The pipeline was retested by the Pressure Pipeline Inspection Company (PPIC) to determine how much additional corrosion has occurred since the original test in 2003

Carbon Fiber on 32 Additional Sections

There are 372 total sections of pipe on the Unit 1 circulating water lines not counting the pipe to the helper cooling towers. Testing in 2003 showed that 117 or approximately 30% of those sections showed some signs of distress with 16 of having complete failure of the reinforcing wires. In 2005, the 38 sections most likely to fail based on a structural analysis were repaired with carbon fiber. In 2007, an additional 32 sections were repaired from the original priority list. That brings the total to 70 sections from the original 117 identified as having some signs of distress. If no further corrosion occurred, the remaining 47 sections would not receive carbon fiber.

Coating Repaired on 38 Sections from 2005 Outage

KPFF is the engineering firm who designed the carbon fiber reinforcing system and supplied the materials. KPFF trained the installing contractor (Gateway) on the methods and procedures for installing the carbon fiber. KPFF believed that the final layer of abrasion resistant coating could be installed after all 38 sections of carbon fiber were completed which in some cases was more than a week after the epoxy had cured. This was a mistake on their part and it resulted in a poor bond between the coating and the carbon fiber. We found large sections of coating failure during an emergency outage on Unit 1 in September of the same year. In 2007, all of the loose coating was removed, the surface of the carbon fiber was lightly sandblasted and a new coating was installed. The carbon fiber was found to still be intact and performing its function of structural reinforcement for the pipeline. KPFF had originally agreed to pay for all of the costs associated with the repair of the coating but, they believed some of the efforts to remove the loose coatings were excessive and asked for some help with the labor costs as they were much more than they had anticipated. IPSC agreed to pay for half

*Balanced Scorecard
Summer 2007*

of the labor costs with KPFF paying for all other costs. In total, KPFF paid \$186,730 and IPSC paid \$123,260 of the direct repair costs.

*P.1041
J. Hill*

Installed Shorting Straps

The original plan for this project was to install a cathodic protection system on both units to slow down the rate of corrosion in the first year of the project which was fiscal year 2004-05. When CORRPRO came out to take the measurements necessary to design the cathodic protection system they found that the pipeline was not electrically continuous even though the design drawings show it that way. It appears that the shorting straps outlined in the original drawings that were supposed to bridge the electrical gap across the slip joints were not installed. This was a significant factor in the cause of the reinforcing wire corrosion as it allowed recirculating currents to develop in the pipeline and it prevented the installation of the cathodic protection system for two more years. During this outage, the grout over each joint was partially removed and shorting straps were welded across the joints to insure continuity.

Now that both units have continuity, work is progressing on the installation of the cathodic protection system. Cache Valley Electric is the prime contractor with Tierra Corrosion Control as a subcontractor. This system should be functional by September of this year.

PPIC Retested the Pipeline

PPIC did the original testing on the pipeline in 2003, and they were contracted to perform the testing again in 2007. The purpose of this testing was to determine how many additional sections of pipe should be reinforced with carbon fiber because of corrosion that occurred since 2003. We have received the results of the testing and we know that additional corrosion has occurred. We have not had time yet to quantify the number of sections that will require carbon fiber--that will take some structural analysis to complete. Once the cathodic protection system is operating, we expect the corrosion to slow down considerably and we only plan to retest every five years.

Balanard Scorecard
Fall 2007
P. 1 of 1 J. Hill

Financial

Objective: Minimize O&M Costs

Initiative: Use New DCS System on Unit 1 to Improve Boiler Combustion to Increase Fly Ash Sales

The DCS system now installed on both units gives better control of all parameters. The units now experience smoother control of critical variables. There are fewer steam temperature and boiler pressure excursions. Any excursions are of a lesser magnitude and shorter duration.

After the first installation of the DCS on Unit 2 the increased control and smoother operation was shown to improve fly ash quality, making more available for sale. The plan on Unit 1 to use improved boiler operation after the DCS was installed to improve the fly ash quality, has taken a back seat to WEPCO compliance.

During the first two years of WEPCO monitoring and system manipulation to ensure compliance, the operators would balance the efficiency of the boiler operation with fly ash quality and WEPCO compliance. NOX is the primary component of WEPCO monitoring which is affected by the boiler operation. Operating the boiler to optimize fly ash quality negatively affects NOX. During the first two years of WEPCO monitoring, the NOX margin was allowed to reduce. The margin was allowed to reduce for the sake of improved fly ash with more for sale and increased revenue. By the end of 2006 the margin had been reduced by approximately 60%. The priority of maintaining NOX limits was increased and fly ash quality was sacrificed to maintain compliance.

To ensure long term compliance, in March 2006 Operations decided that the NOX margin would be maintained at the current value with no more loss of the margin. Many factors are inputs to NOX production. The most effective way to impact NOX is with boiler excess air control and utilization of the overfire air system. Reducing excess air to improve NOX hurts fly ash quality. Use of the overfire air system hurts the fly ash quality. For six months prior to the outage and installation of the DCS, overfire air was in service 47% of the time. For the six months since the installation of the DCS, the overfire air system has been in service 60% of the time. The fly ash quality has deteriorated a similar amount.

Maintaining NOX limits on U2 can usually be accomplished without the use of overfire air due to the newer low NOX burners.

Further tuning and adjustment of the DCS is ongoing. The Optimax system in the DCS is being refined. IPSC will continue working with the tools in the DCS to improve the fly ash while maintaining WEPCO compliance.